Montana
Office of Public Instruction
Denise Juneau, State Superintendent
In-state toll free 1-888-231-9393
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Mathematics
Model Teaching Unit

Ko'ko'hasenestôtse

"The Art of Clicking Things Together"

Created by: Lisa Scott

Grade 8 – Approximate Duration: 110 minutes

Stage 1 Desired Results

Established Goals:

Data Analysis Mathematics Content Standard 2: A student, applying reasoning and problem solving, will use data representation and analysis, simulations, probability, statistics, and statistical methods to evaluate information and make informed decisions within a variety of relevant cultural contexts, including those of Montana American Indians.

- **2.1 Representing and Comparing Data:** Collect data from a variety of contexts (e.g., science, history, and culture, including Montana American Indians). Organize and represent data in box plots, scatter plots, histograms, and circle graphs using technology when appropriate.
- **2.2 Evaluating Data and Making Conjectures:** Interpret, analyze, and evaluate data using mean, median, range, and quartiles to identify trends and make decisions and predictions about data within scientific and cultural contexts, including those of Montana American Indians.
- **2.3 Finding Probability and Predicting**: Create sample spaces and simulations from events found in different cultures, including those of Montana American Indians, determine experimental and theoretical probabilities, and use probability to make predictions.

IEFA: Essential Understanding 3: The ideologies of Native traditional beliefs and spirituality persist into modern day life as tribal cultures,
traditions, and languages are still practiced by many American Indian people and are incorporated
into how tribes govern and manage their affairs.
Additionally, each tribe has its own oral histories, which are as valid as written histories. These histories pre-date the "discovery" of North America.

Understandings:	Essential Questions:
Students will understand… • how to play Ko'ko'hasenestôtse, a game from the Cheyenne people. • how to use experimental and theoretical probabilities to make predictions. • how a large number of trials in an experiment can predict the theoretical probability of the event.	• How is the scoring of Ko'ko'hasenestôtse determined? • How is the experimental probability determined? • How is the theoretical probability determined? • How is the Law of Large Numbers used to predict the theoretical probability?

Mathematics Grade 8 – Ko'ko'hasenestôtse *The Art of Clicking Things Together (continued)*	
Students will be able to… ●understand and play the game of Ko'ko'hasenestôtse. ●collect and organize data into a table while simulating the game. ● determine the experimental probability of each throw. ● determine the sample space of the game (by listing or tree diagramming). ● use the Law of Large Numbers to predict the theoretical probability. ● determine the theoretical probability of each throw. ● use the probabilities to make predictions for future throws in the game of Ko'ko'hasenestôtse.	*Students will know…* ● the definitions of trial, experimental probability, sample space, Law of Large Numbers and theoretical probability.

Stage 2 Assessment Evidence

Performance Tasks: Worksheet with data collection, sample space, and probabilities. Worksheet with questions answered and turned in.
Other Evidence: Observation of game and data collection. Participation in class discussions. Individual questioning of students.

Stage 3 Learning Plan

Learning Activities:

1. **State the "Understandings" for the lesson**
2. **Warm Up Activity**

Put the following on the board and ask students to complete.

- Write 3 out of 4 as a ratio. (3/4, 3 to 4, or 3:4)
- What does probability mean? (How likely it is that an event will happen. The ratio of the number of favorably outcomes out of the total number of possible outcomes.)
- What is a tree diagram? Give an example. (A branching diagram to show all possible outcomes.)

3. **Handout, read and discuss the overview of the Northern Cheyenne Reservation**
4. **Inform the students that they will be playing Ko'Ko'hasenestôtse** (The Art of Clicking Things Together), which is a game from the Cheyenne people. Explain that it is sometimes referred to as Monshimout, but according to Dr. Richard Little Bear, President of Chief Dull Knife College, this name is an anglicized version of , Móhenėšemahtôtse?, a Northern Cheyenne word meaning "card game". The Ko'ko'hasenestôtse game, referred to as "Monshimout", can be found at:

(http://www.manataka.org/page103.html#Cheyenne%20Basket%20Game). Distribute directions using the desired format.

5. **Handout the Ko'ko'hasenestôtse Game Worksheet found at the end of this lesson.**

- Assign student partners
- Ask students to complete #1 on worksheet
- Handout the materials to play the game
- Have partners play the game as many time as they can in 20 minutes and record data in Table 1 & 2

- Ask students to complete #2 through #5 on worksheet

6. **Have a class discussion about #2 through #5**
7. **Discuss how to determine the sample space and possible methods for listing all possible outcomes (list or tree diagramming)**
8. **Ask students to complete #6 on the worksheet**
9. **Discuss the number of outcomes in the sample space as a class (32 outcomes)**
10. **Compile the class data by putting three columns on the board or in a projected spreadsheet**
    - The first column would be a copy of the first column of Table 1
    - Ask pairs to report how many tallies they had for each throw
    - Record the data for each pair and then find the total for the whole class for each throw
    - Write the total in the second column
    - In the third column write the experimental class probability
    - Ask students to copy these into Table 2

Throw	Total Number of Class Tallies	Class Experimental Probability
2B, 2P, 1C…		

11. **Ask students to complete Table 2 and discuss the theoretical probabilities and how they were determined**
12. **Answer questions #8 - #10**
13. **Discuss the answers to #8 - #10 as a class and discuss the definition of the law of large numbers**
14. **Ask students to complete #11 and #12 with their partner**
15. **Turn in worksheet**

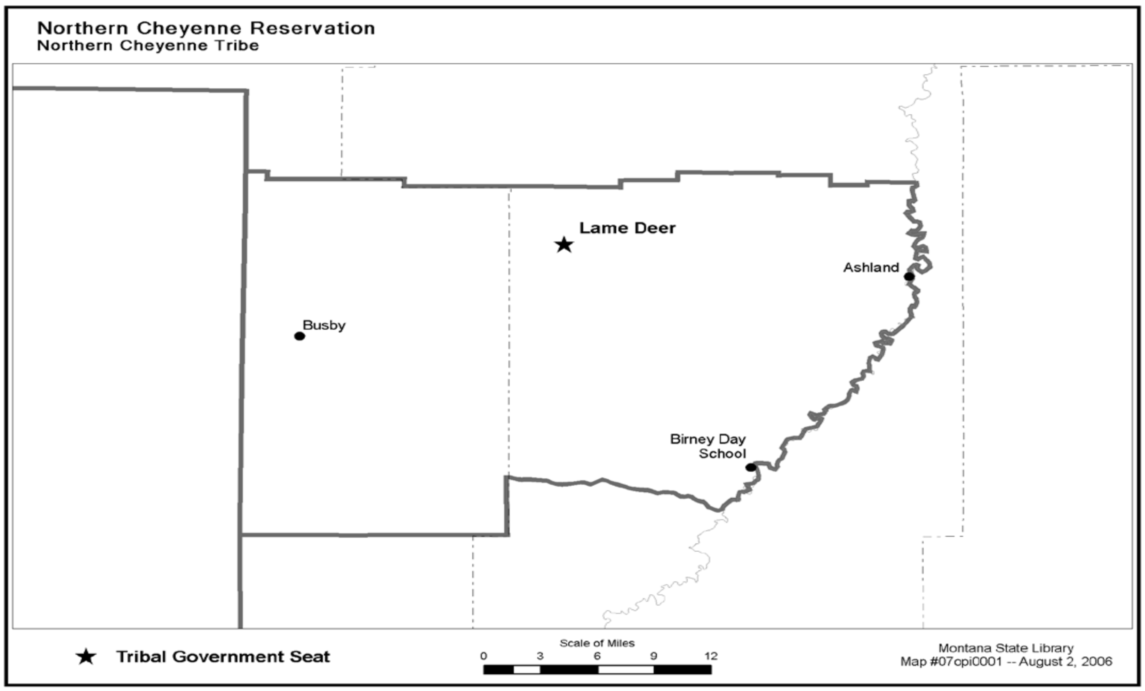
Summary: You have learned about the Cheyenne Basket Game called Ko'ko'hasenestôtse and a little bit of history on the people who live in Montana. You should now have a good understanding of experimental and theoretical probabilities and the law of large numbers.

Materials/Resources Needed:

- Copies of the overview of the Northern Cheyenne Reservation for each student found at end of lesson or (http://www.opi.mt.gov/pdf/indianed/resources/MTIndiansHistoryLocation.pdf).
- Copies of “Ko'ko'hasenestôtse Game” for each student. According to Dr. Richard Little Bear, President of Chief Dull Knife College, this Web site refers to this game as “Monshimout,” which is an anglicized version of, Móhenėšemahtótse?, a Northern Cheyenne word meaning “card game.”
- (http://www.manataka.org/page103.html#Cheyenne%20Basket%20Game)
- “Ko'ko'hasenestôtse Game Worksheet” for each student, found at end of lesson.
- A “basket” (Dixie cup or small box) for each pair of students
- Five two colored chips (two that have “bear paw” markings on one side and three that have “cross markings” on one side and the opposite sides are blank) for each pair of students
- Eight “sticks” (straws or toothpicks) for each player

Northern Cheyenne Reservation

NORTHERN CHEYENNE TRIBE



Location

The Northern Cheyenne Reservation, situated in southeastern Montana, lies within the counties of Big Horn and Rosebud. The Crow Reservation borders it on the west. The reservation consists of open ponderosa-pine plateau and valley country with an annual rainfall of approximately 16 inches. The topography ranges from about 4,800 feet to a low of a little less than 3,000 feet. The reservation headquarters and the center for business activities and population are in Lame Deer. The reservation itself is divided into five districts; Busby, Lame Deer, Ashland, Birney, and Muddy.

Population

Total number of enrolled tribal members Approximately 7,374
Even though there are over 7,000 enrolled members, about 4,199 members live on the reservation scattered through the five district communities.

There is also a relatively small population of non-Indians and other tribal members living on the reservation.

Land Status

Total acres within the reservation's boundary 444,774.50 acres
Individually allotted lands 113,277.70 acres
Tribally owned lands 326,546.81 acres
Fee title or state lands 4,827.70 acres
Non-Indians own about 30 percent of the fee or state lands on the Northern Cheyenne Reservation. The Tribal Council has selected a Land Acquisitions Committee whose primary policy is directed to the purchase of land into Tribal ownership. The Committee thus assures that Indian land is retained in Indian ownership.

Historic al Background

The Cheyenne Indians are part of a linguistic group of the Algonquian language stock. Originally, it is believed that the ancestors of the Cheyenne lived south of the Hudson Bay and James Bay areas and slowly moved west into what is now northwestern Minnesota where the Red River forms a border between Minnesota and the Dakotas. During the late 1600s, they settled among the Tribes of the upper Missouri River and began farming rather than subsisting as small game hunters and fishermen. During the early 1700s, they were still primarily farmers growing corn, but they also hunted buffalo. The Cheyenne acquired the horse around 1750, and made the transition from a horticultural existence to a horse culture within a matter of several generations. Hunting buffalo became a way of life as they migrated as far south as New Mexico and Texas. The Cheyenne participated in the treaty making in 1825 near what is now Fort Pierre, South Dakota. A few years later, the larger part of the tribe (now the southern Cheyenne) moved southward and occupied much of the Arkansas River in Colorado and Kansas. The remainder continued to inhabit the plains from the headwaters of the North Platte up on to the Yellowstone River in Montana. The division of the tribe was recognized by the Fort Laramie Treaty of 1851. In the Battle of the Little Bighorn in 1876, the Northern Cheyenne joined the Sioux in what the Cheyenne call "where Long Hair was wiped away forever." Cheyenne oral history recalls a time when George A. Custer smoked a Cheyenne pipe and vowed never to fight the Cheyenne again. The ashes from the pipe dropped on his boot and scattered on the ground. These ashes were wiped away signaling Custer's commitment never to fight the Cheyenne again. Although the Cheyenne won the battle it was the beginning of the end for them as they were exiled to Indian Territory in Oklahoma to be colonized with the Southern Cheyenne. A small band escaped in a desperate effort led by Chief Dull Knife (Morning Star) and Chief Littlewolf. These two chiefs, in one of the most heroic episodes of western history, bravely fought against overwhelming odds, leading a small band of men, women, and children back to their homelands. The Northern Cheyenne call themselves "the Morning Star people." The name is taken and used in respect of Chief Dull Knife who was also known as Morning Star. Chief Littlewolf and Chief Dull Knife are buried side by side in the Lame Deer cemetery. By Executive Order of November 26, 1884, a tract of country east of the Crow Reservation was set apart as a reservation for the Northern Cheyenne. The reservation was expanded by another Executive Order in 1900 to its present boundaries.

(2007. *Montana Indians: Their History and Location.* Helena, MT: Office of Public Instruction. http://www.opi.mt.gov/pdf/indianed/resources/MTIndiansHistoryLocation.pdf)

Ko'ko'hasenestôtse Game Worksheet

Name ____

1. Predict how many times you think you would need to throw the stones before you would see the winning throw of 2 bears and 3 crosses. ______________________ (Write your prediction as a ratio of 1 success or win to the number of throws.)

2. Play the game of Ko'ko'hasenestôtse with a partner. Tally each trial (the number of times you obtain "sticks" from your partner) for the following throws. **B = blank, P = bear paw and C = cross**. Play the game one, two or three times. If you play more than one game, continue to tally in the same table below and record how many throws it took to win each game. Determine the experimental probability for each throw using all the data from each game combined. (Experimental probability is the number of successes out of the number of trials).

Throw	# of Sticks	Tally	Experimental Probability
2 blanks, 2 bears, 1cross	**0**		
4 blanks, 1 bear, 0 crosses	**0**		
5 blanks, 0 bears, 0 crosses	**1**		
3 blanks, 2 bears, 0 crosses	**1**		
1 blank, 2 bears, 2 crosses	**1**		
2 blanks, 0 bears, 3 crosses	**3**		
0 blanks, 2 bears, 3 crosses	**8**		
Other	**0**		

Table 1

Game Number	**Number of throws to win the game**
1	
2	
3	

Table 2

3. Which throw(s) from Table 1 seemed the most likely to happen? Explain.

4. Which throw(s) from Table 1 seemed the least likely to happen? Explain.

5. Using Table 2, how many times did you have to throw until someone won the game? Do you think this would be the same or close to the same if you were to play again? Why or why not?

6. Determine the sample space (every possible way the five stones may land) by listing or tree diagramming. Show all of your work.

7. Copy the experimental probabilities from Table 1 in step 2. Your teacher will help you compile the class data. Determine the experimental probability for each throw using the combined class data. Determine the theoretical probability of each throw and write those in Table 3. (Theoretical probability is the number of successes out of the total number of outcomes in the sample space.)

Throw	# of Sticks	Game Experimental Probability	Class Experimental Probability	Theoretical Probability
2 blanks, 2 bears, 1cross	**0**			
4 blanks, 1 bear, 0 crosses	**0**			
5 blanks, 0 bears, 0 crosses	**1**			
3 blanks, 2 bears, 0 crosses	**1**			
1 blank, 2 bears, 2 crosses	**1**			
2 blanks, 0 bears, 3 crosses	**3**			
0 blanks, 2 bears, 3 crosses	**8**			
Other	**0**			

Table 3

8. How do the game experimental probability and the class experimental probability compare? Which do you think more accurately reflects the probability of each throw if you were to play multiple times? Explain why.

9. How do the experimental probabilities and theoretical probability compare? Should they be close in value? Why or why not? Which probability is a more accurate prediction of this game if you were to play it multiple times? Why?

10. Which experimental probability is closest to the theoretical probability? If you were to continue to throw the stones, how many times do you think you would need to throw and accurately predict the theoretical probability? Why do you think this? (Law of large numbers states that if you repeat a random experiment a large number of times, your outcomes should on average equal the theoretical average.)

11. Compare the theoretical probability to the prediction you made in question 1. How close was your prediction? Use the theoretical probability to predict how many times you should expect to get 2 bears and 3 crosses if you were to throw the stones 500 times? Show your work.

12. Do you think the Cheyenne people used the theoretical probability of each throw to determine the number of sticks you would obtain? Why or why not? Use the probabilities in your explanation.

Ko'ko'hasenestôtse Game Worksheet *(Answer Key)*

Name ____

1. Predict how many times you think you would need to throw the stones before you would see the winning throw of 2 bears and 3 crosses. *Any answer is acceptable (approx. 1/32)* (Write your prediction as a ratio of 1 success or win to the number of throws.)

2. Play the game of Ko'ko'hasenestôtse with a partner. Tally the number of times you obtain "sticks" from your partner for the following throws. **B = blank, P = bear paw and C = cross**. Play the game one, two or three times. If you play more than one game, continue to tally in the same table below and record how many throws it took to win each game. Determine the experimental probability for each throw using all the data from each game combined. (Experimental probability is the number of successes out of the number of trials). *Sample Game*

Throw	# of Sticks	Tally	Experimental Probability
2 blanks, 2 bears, 1cross	**0**	IIII	$\frac{4}{25}$
4 blanks, 1 bear, 0 crosses	**0**	II	$\frac{2}{25}$
5 blanks, 0 bears, 0 crosses	**1**		$\frac{0}{25}$
3 blanks, 2 bears, 0 crosses	**1**	I	$\frac{1}{25}$
1 blank, 2 bears, 2 crosses	**1**	II	$\frac{2}{25}$
2 blanks, 0 bears, 3 crosses	**3**	I	$\frac{1}{25}$
0 blanks, 2 bears, 3 crosses	**8**		$\frac{0}{25}$
Other	**0**	IIIIIIIIIIIIIII	$\frac{15}{25}$

Table 1

Game Number	Number of throws to win the game
1	*29*
2	*32*
3	*35*

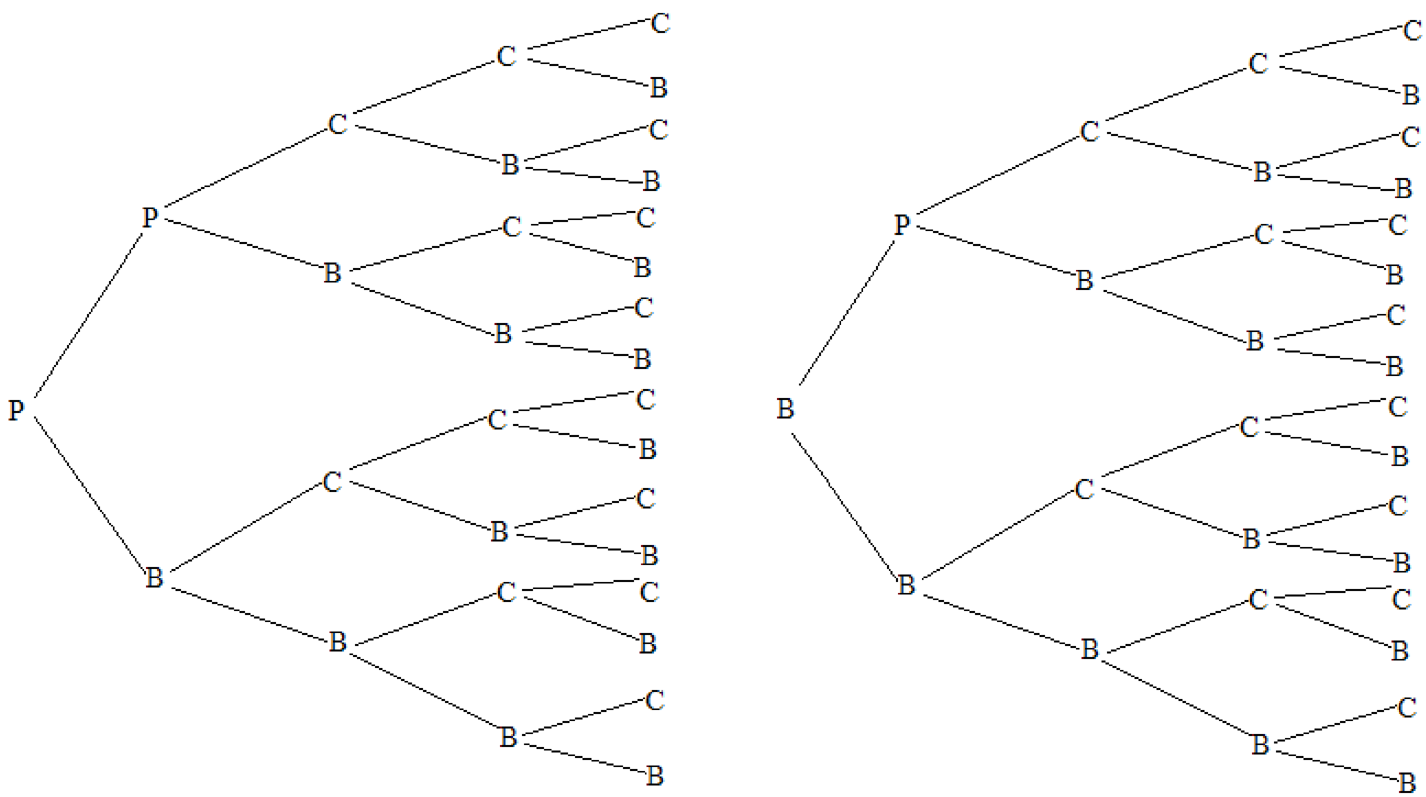
Table 2

3. Which throw(s) from Table 1 seemed the most likely to happen? Explain. *(Sample response) The "other" and 2B, 2P, 1C. The "other" had 15 tallies out of 25. These two seemed most likely. The 2B, 2P, 1C occurred 4 out of 25. It was the second most likely to occur.*

4. Which throw(s) from Table 1 seemed the least likely to happen? Explain. *(Sample response) The 5B and 2P, 3C happened zero times each. 3P, 2C and 2B, 3C only happened one time each. None of these seem very likely to occur.*

5. Using Table 2, how many times did you have to throw until someone won the game? Do you think this would be the same or close to the same if you were to play again? Why or why not? *(Sample response) I threw 25 times and only collected 6 of my opponent's sticks. So, I know I would have to throw more than 25 to win. I think the results would be similar. The chances of each throw shouldn't change. So, the results should be similar.*

6. Determine the sample space (every possible way the five stones may land) by listing or tree diagramming. Show all of your work.



Sample Space (32 outcomes)

PPCCC	*PPCCB*	*PPCBC*	*PPCBB*	*PPBCC*	*PPBCB*	*PPBBC*
PPBBB	*PBCCC*	*PBCCB*	*PBCBC*	*PBCBB*	*PBBCC*	*PBBCB*
PBBBC	*PBBBB*	*BPCCC*	*BPCCB*	*BPCBC*	*BPCBB*	*BPBCC*
BPBCB	*BPBBC*	*BPBBB*	*BBCCC*	*BBCCB*	*BBCBC*	*BBCBB*
BBBCC	*BBBCB*	*BBBBC*	*BBBBB*			

7. Copy the experimental probabilities from Table 1 in step 2. Your teacher will help you compile the class data. Determine the experimental probability for each throw using the combined class data. Determine the theoretical probability of each throw and write those in Table 3. (Theoretical probability is the number of successes out of the total number of outcomes in the sample space.)

Throw	**# of Sticks**	**Game Experimental Probability**	**Class Experimental Probability**	**Theoretical Probability**
2 blanks, 2 bears, 1cross	**0**	$\frac{4}{25}$	$\frac{3}{32}$	$\frac{3}{32}$
4 blanks, 1 bear, 0 crosses	**0**	$\frac{2}{25}$	$\frac{2}{32}$	$\frac{2}{32}$
5 blanks, 0 bears, 0 crosses	**1**	$\frac{0}{25}$	$\frac{1}{32}$	$\frac{1}{32}$
3 blanks, 2 bears, 0 crosses	**1**	$\frac{1}{25}$	$\frac{1}{32}$	$\frac{1}{32}$
1 blank, 2 bears, 2 crosses	**1**	$\frac{2}{25}$	$\frac{3}{32}$	$\frac{3}{32}$
2 blanks, 0 bears, 3 crosses	**3**	$\frac{1}{25}$	$\frac{1}{32}$	$\frac{1}{32}$
0 blanks, 2 bears, 3 crosses	**8**	$\frac{0}{25}$	$\frac{1}{32}$	$\frac{1}{32}$
Other	**0**	$\frac{15}{25}$	$\frac{20}{32}$	$\frac{20}{32}$

Table 3

8. How do the game experimental probability and the class experimental probability compare? Which do you think more accurately reflects the probability of each throw if you were to play multiple times? Explain why. *(Sample response) The probabilities are close in value. I think they should be. They would probably get closer the more times I throw the stones. They are close because the chances of each throw should stay the same, as the tree diagram shows.*

9. How do the experimental probabilities and theoretical probability compare? Should they be close in value? Why or why not? Which probability is a more accurate prediction of this game if you were to play it multiple times? Why? *(Sample response) The class probability and the theoretical probability are somewhat close in value. I think they should be. They would probably get even closer in value the more times I throw the stones. I think the class probability begins to predict what should happen for anytime I play. The theoretical is what should happen. I think they should be close because the chances of each throw shouldn't change very much, as the tree diagram shows.*

10. Which experimental probability is closest to the theoretical probability? If you were to continue to throw the stones, how many times do you think you would need to throw and accurately predict the theoretical probability? Why do you think this? (Law of large numbers states that if you repeat a random experiment a large number of times, your outcomes should on average equal the theoretical average.) *(Sample response) The class probability is closer to the theoretical probability. I think the more times I throw the stones the closer the probability will become to the theoretical probability.*

11. Compare the theoretical probability to the prediction you made in question 1. How close was your prediction? Use the theoretical probability to predict how many times you should expect to get 2 bears and 3 crosses if you were to throw the stones 500 times? Show your work. (Sample response) My prediction was fairly close. I would take the theoretical probability of $\frac{1}{32}$ and multiply it to the 500 times I would throw the stones. So, I think I would get 2 bears and 3 crosses about 15 or 16 times in 500 throws.

12. Do you think the Cheyenne people used the theoretical probability of each throw to determine the number of sticks you would obtain? Why or why not? Use the probabilities in your explanation.

(Sample response) I don't think they took the probabilities into consideration when assigning the number of sticks you would take from your opponent. I think this because the theoretical probability of getting 2B, 2P, 1C is $\frac{3}{32}$ and you don't get to take any sticks if you throw this. 1B, 2P, 2C is also $\frac{3}{32}$ and you get to take 1 stick. 4B, 1P is $\frac{2}{32}$ and you don't get to take any sticks. 5B and 3B, 2P are both $\frac{1}{32}$ and you get 1 stick for each. But 2B, 3C is $\frac{1}{32}$ and you get to take 3 sticks. 2P, 3C is $\frac{1}{32}$ and you take all eight. It seems to me that the probabilities that are the same should have the same number of sticks taken and the combinations with the lowest probability should be worth the most sticks and the combinations with the higher probabilities should be worth the least number of sticks.